
Possible Sites for an Off-Axis Detector with the NuMI Beam

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for M. Marshak (Minnesota) & S. Menary (York)

UCL Off-axis meeting, 16 September 2002

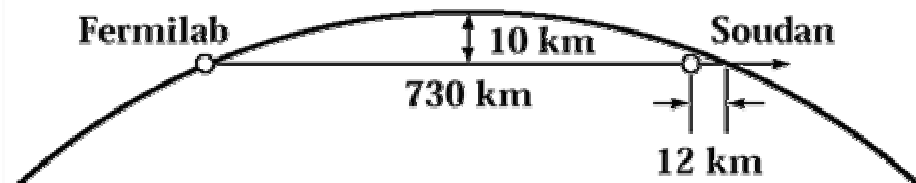
- Requirements
- List of possible sites in U.S. & Canada
- The front-runner: the LTV site(s)

Site Properties

- **Detector mass of 20-25 kT of density one, that is, lab dimensions of 275 m long by 16 m wide by 12 m high – but, other geometries possible !**
- **Depth of 10-15 m**
- **8 to 10 km from beam centerline**
- **Prefer natural drainage**
- **Good highway access**
- **Good access to electrical power, communications**
- **Land available with low environmental and political risk**

Off-Axis Detector Sites

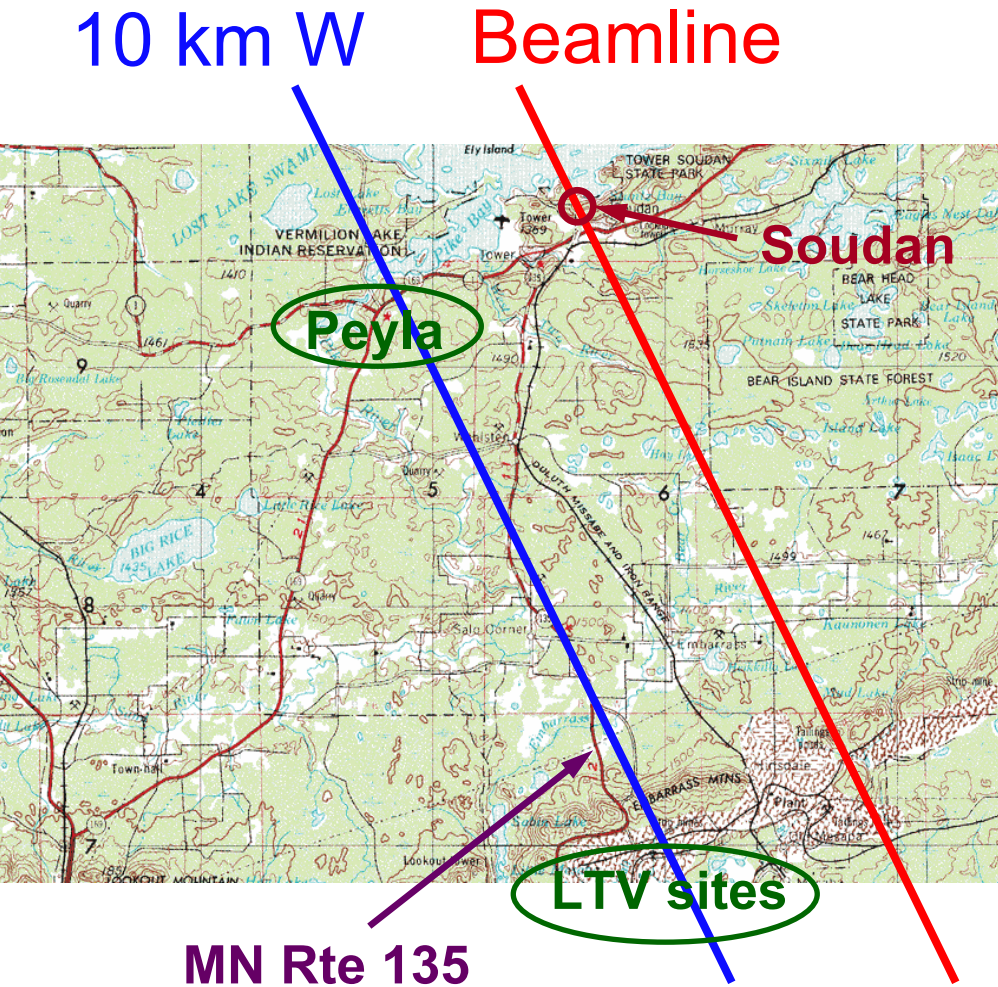
- Maximum beam depth ~12 km, so lots of off-axis sites



- Focus on sites w/ $L > 700$ km
- \rightarrow # w/ road access is roughly 6



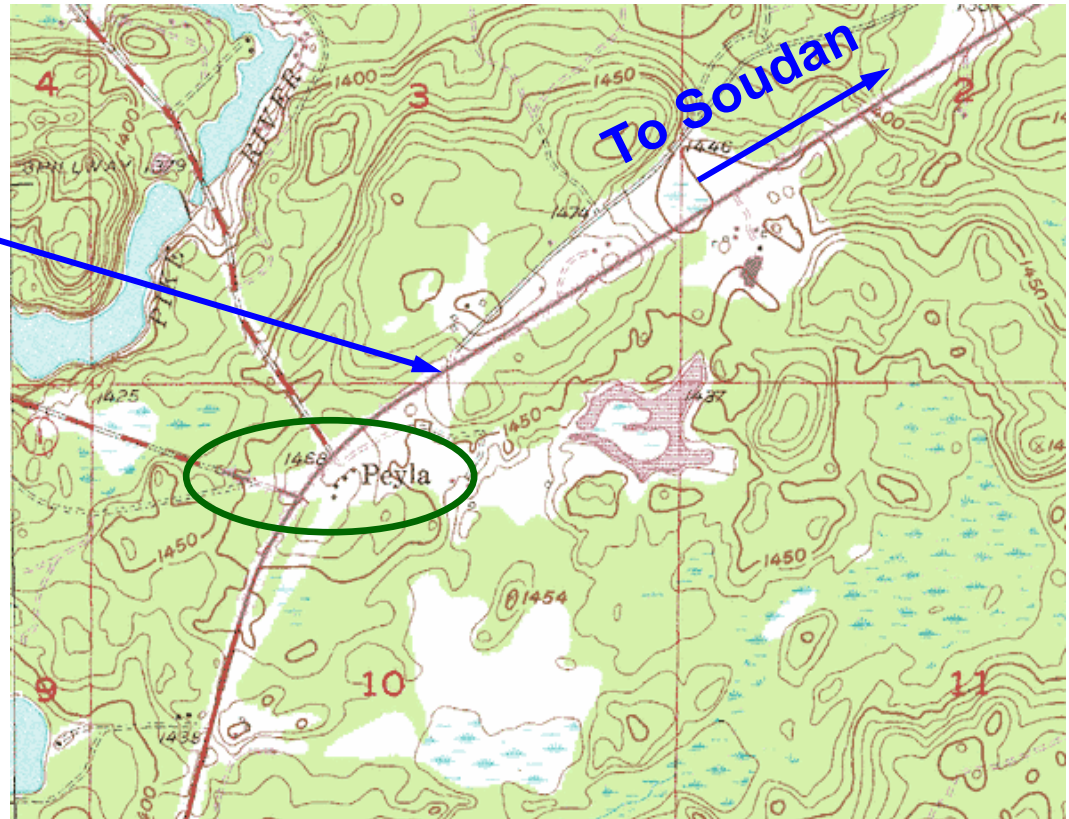
Sites Nearby to Soudan



- **Peyla & LTV are most promising nearby sites – can take advantage of infrastructure at Soudan**
- **LTV is in the Vermillion iron range— surface mining of natural and taconite ores**
- **Cliffs-Erie and USX own about 25 miles by 5 miles comprising LTV**
- **No current mining or interest in mining in this area**

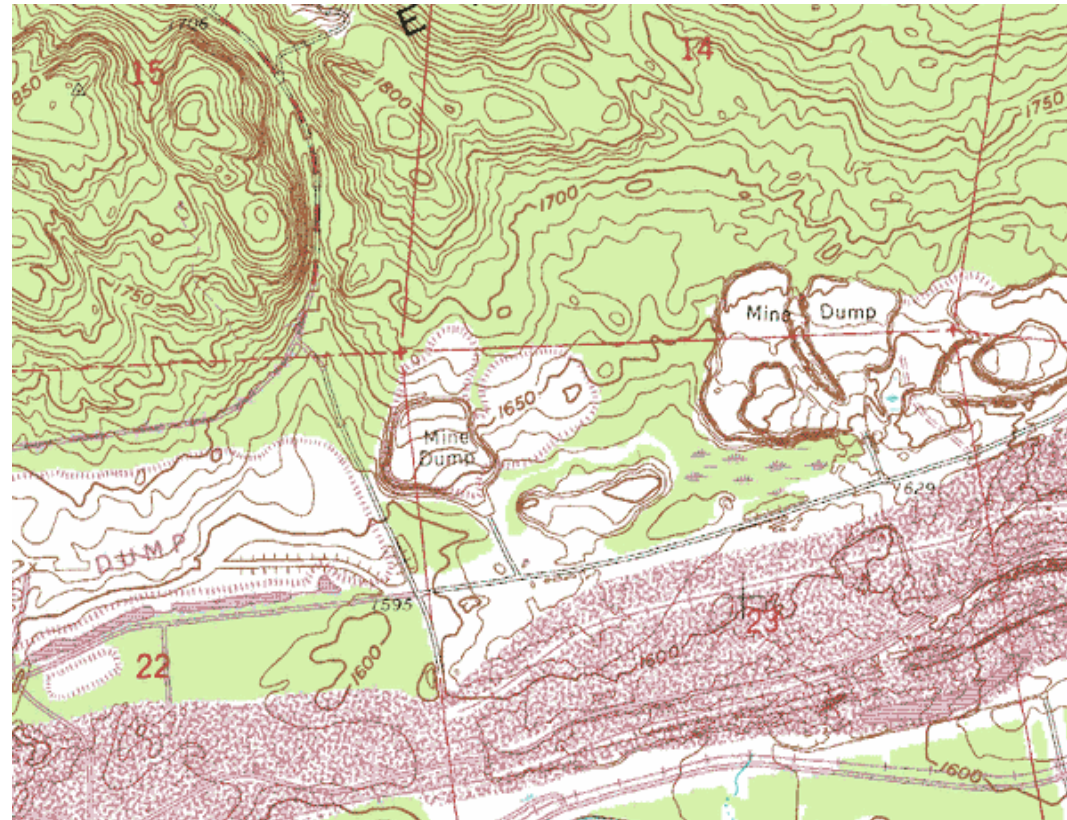
Peyla

- Y-store;
- road access from MN 169;
- power; fiber?; cell phone;
- closest to Soudan;
- some marshes;
- near Lake Vermilion

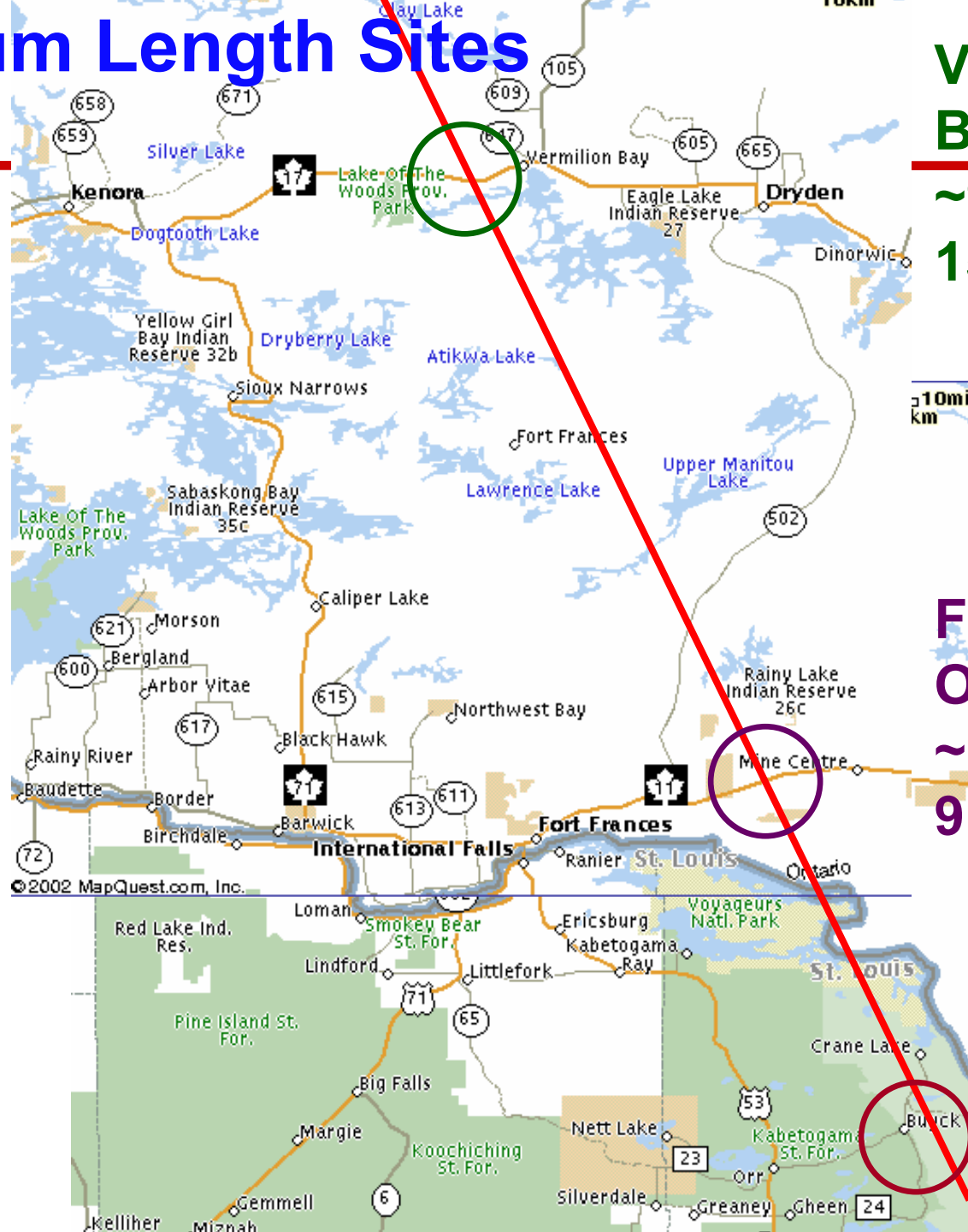


LTV – our best site, more later...

- **Large site;**
- **previously mined;
has huge piles of
crushed rock !**
- **road, rail access;**
- **power; fiber;
cell phone;**
- **~710 km from FNAL**



Maximum Length Sites



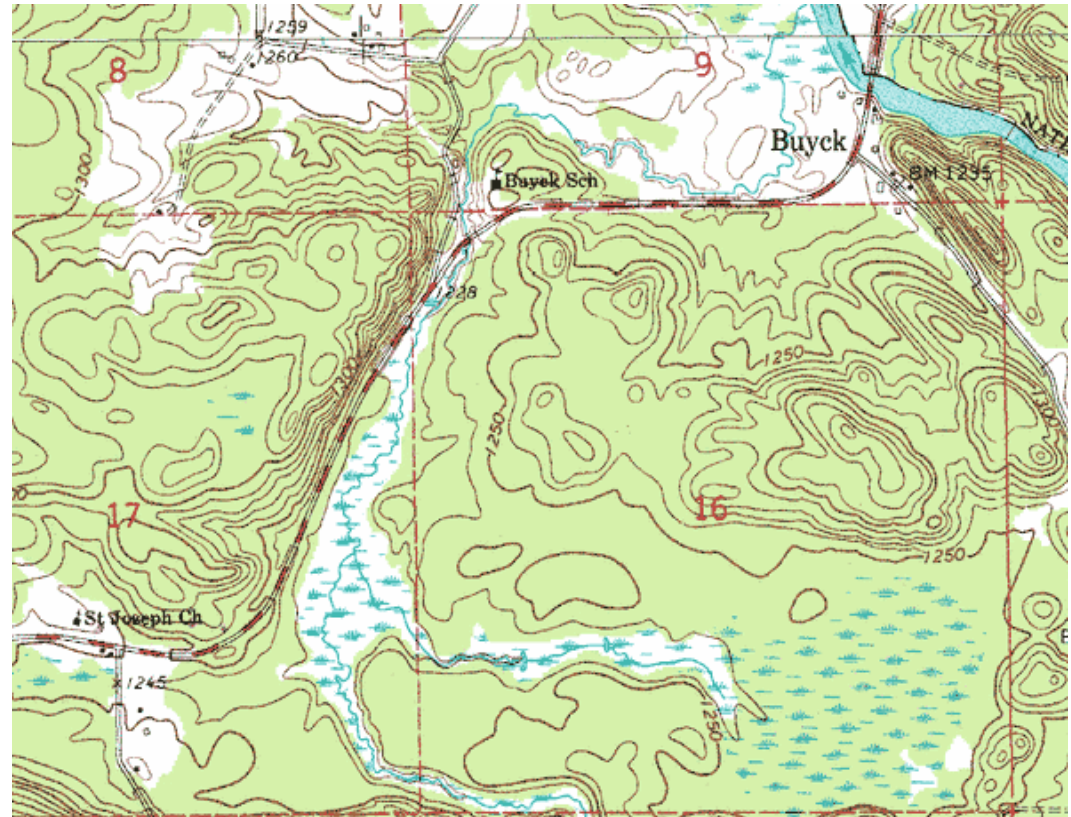
**Vermilion
Bay, Ontario**
~950 km,
15.6 km up

**Fort Frances,
Ontario**
~875 km,
9 km up

Buyck, MN
775 km,
2 km up

Buyck, Minnesota, U.S.

- Road access from US 53 at Orr, MN;
- power; fiber;
- no cell phone;
- scrub forest and grassland;
- bar and gas nearby;
- ~775 km from FNAL



Ash River, Minnesota, U.S.

- Road access from US 53 south of International Falls;
- power; cell phone; fiber?;
- bar and gas;
- scenic; near Voyageur's Park;
- ~825 km from FNAL



Fort Frances, Ontario, Canada

- **40 km east of Fort Frances on Ontario 11;**
- **rail access;**
- **fiber(?); cell phone; power;**
- **empty area with boreal forest**



Vermilion Lake, Ontario, Canada

- 60 km east of Kenora on Ontario 17;
- rail access; power; fiber(?); cell phone;
- bar and gas;
- Trans-Canada pipeline compressor plant; quarry;
- Fisheries Research Station;
- ~975 km from FNAL

Compressor station



Vermilion Lake Area

- **Scott Menary visiting the Kenora Ministry of Development & Mines**



Vermilion Lake Possible Sites

**Stewart Lake
(3km W of beam)**

**Compressor
station**

Gravel Pit



Gravel Pit Area

- **Land owned by Ministry of Transportation, used in past for road repair work**



Stewart Lake Area

- **Scott has already identified a venue for collaboration meetings...**

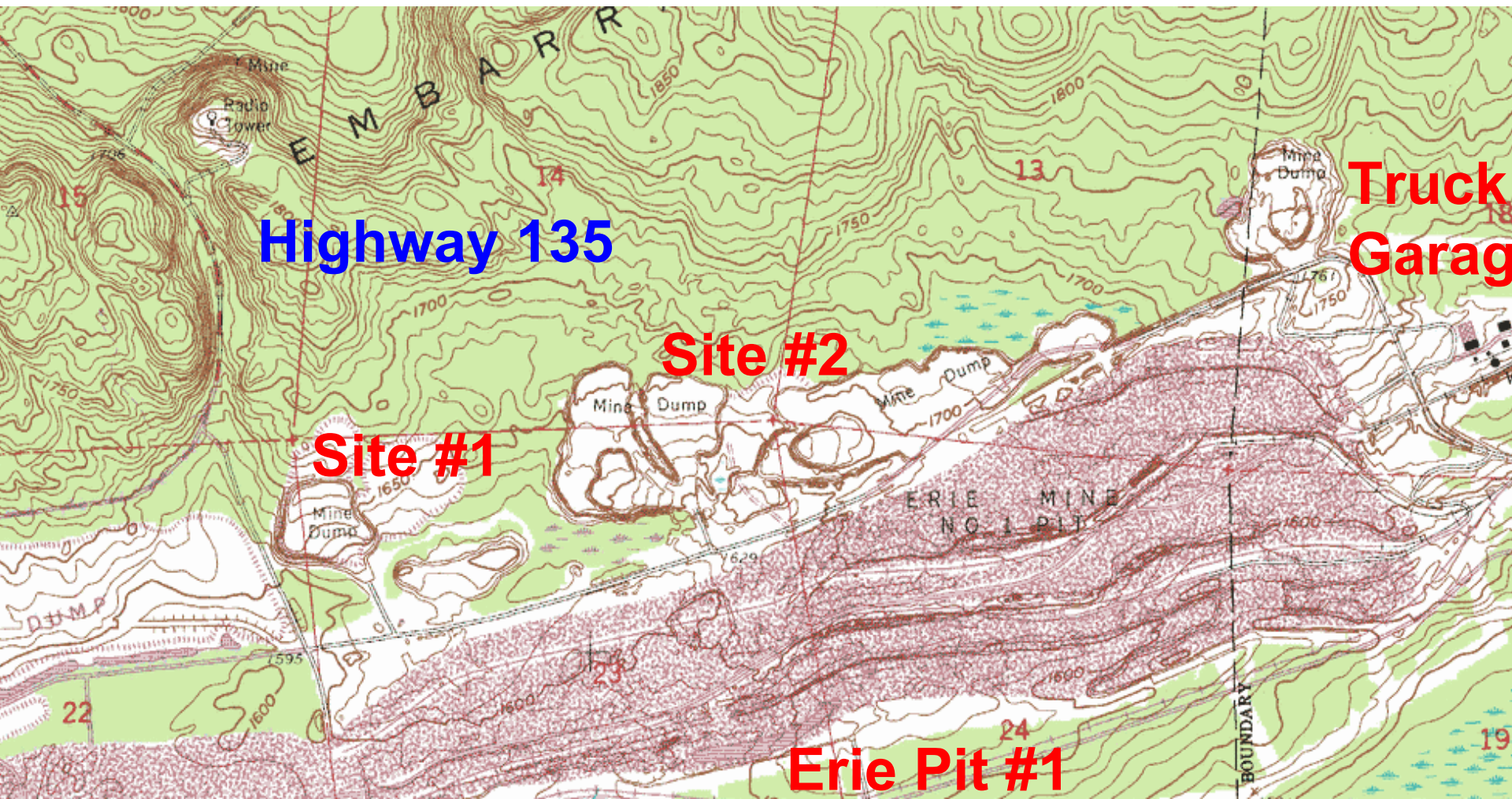


Back to Minnesota: LTV Mine, Aurora, MN

– our most promising site

- Recent developments:

U. Of Minnesota is funding engineering studies on this site...





**LTV Mine, Aurora MN –
our most promising site**

Highway 135



Site #1

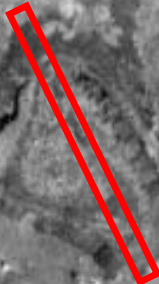
47° 35.241' N

92° 13.208' W

**10.3 km from
beam centerline**



250 m x 16 m





Ground photos and GPS
coordinates by Nate Burchell
and Glenn Johnson



ite #2

9.1 km from beam centerline





250 m x 16 m

This is a black and white aerial photograph of a coastal or estuarine environment. The image shows a complex network of water channels, marshes, and possibly some man-made structures or cleared areas. A red rectangle is drawn on the right side of the image, indicating a specific area of interest. A blue text box with yellow text is located in the upper left quadrant, providing dimensions for the area of interest: 250 m x 16 m. The terrain appears to be a mix of water and land, with varying textures and tones suggesting different vegetation or sediment types.



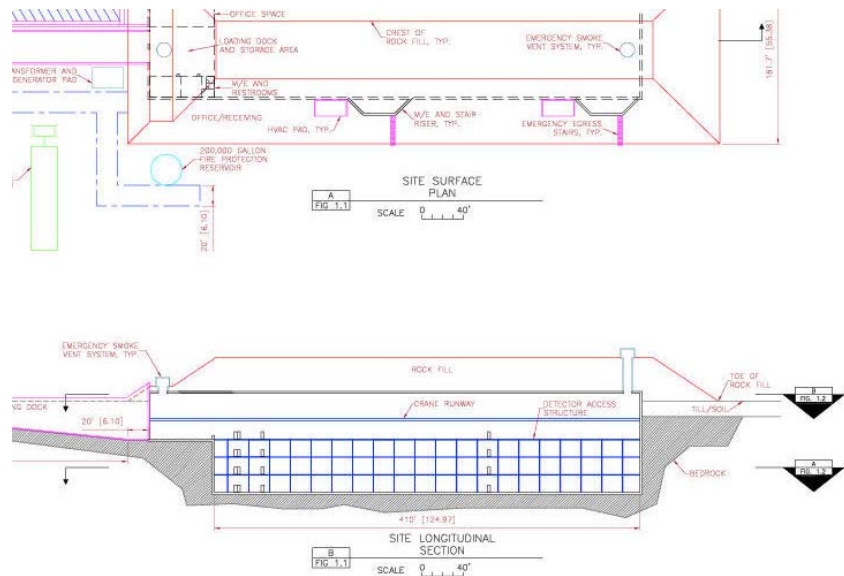
Truck Garage



Not On the Presses.

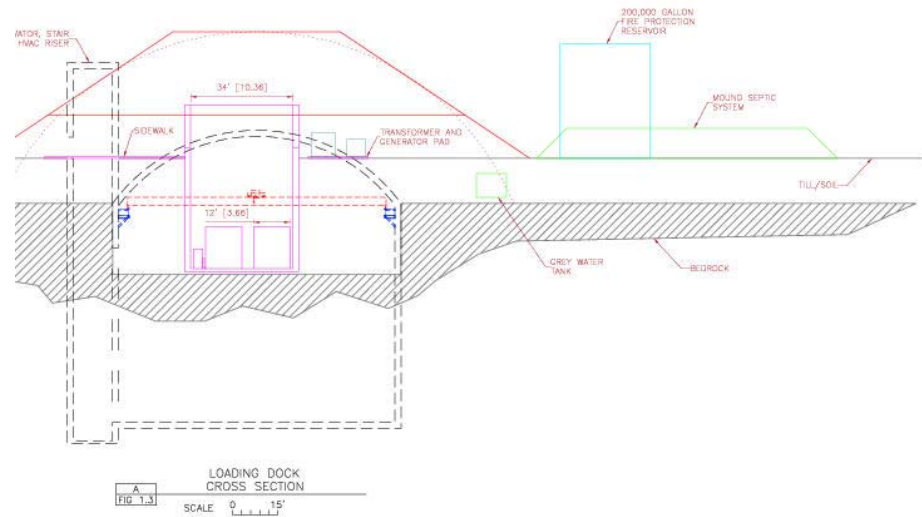
Detector Building Engineering

- From CNA Consulting Engineers
 - (did design/engineering for MINOS Hall)



Off Axis NuMI Neutrino Detector
U of M Project #298-03-1113

Figure 2.1



Off Axis NuMI Neutrino Detector
U of M Project #298-03-1113

Figure 2.3

Conclusions

- **LTV site is still most flexible and likely lowest cost and risk**
- **Peyla and Buyck sites appear feasible. Peyla is convenient to Soudan.**
- **Ash River site appears high risk for not much more baseline than Buyck site**
- **Sites east and northeast of Fort Frances appear difficult**
- **Vermilion Lake site appears feasible and perhaps desirable if Δm^2 is small**

Outamanoan Lake

- **60 km NE of Fort Frances on Ontario 502;**
- **very empty area;**
- **no bar; no gas;**
- **no power; cell phone; no land phone**

